Chapter 8
Philosophy of Technoscience: From Cis-Continental to Trans-Continental

Taking Stock: The Noumenal Turn in Technoscience

The previous chapters explored how four (interacting and overlapping) continental approaches (dialectics, dialectical materialism, psychoanalysis and phenomenology) offer hints and guidance for coming to terms with the revolutionary dynamics and disruptive impact of contemporary technoscience. Hegelian dialectics provides a conceptual scaffold for developing a comprehensive view of the terrestrial system and even for addressing the Cambrian explosion currently unfolding in laboratories around the globe, as a result of technoscientific developments such as synthetic biology and CRISP-Cas9. Dialectical materialism likewise offers a conceptual framework for addressing the rapidly aggravating disruption of the metabolism between nature and global civilisation, and the ongoing convergence of biosphere and technosphere, exemplified by the synthetic cell. Francophone psychoanalysis, closely aligned with dialectical thinking, adds to our understanding of the specificity of technoscience, both as a practice and as a discourse, where technoscientific research emerges as a questionable vocation driven by a desire to control, but at the same time ostensibly out of control. The dialectical methodology of psychoanalysis was exemplified with the help of case histories, moreover, involving Majorana particles, gene drives, malaria mosquitoes and nude mice. The latter represent technoscientific commodities, exemplifying the assembly-line production of human-made organisms (the commodification of life as such). Subsequently, we demonstrated how Heideggerian phenomenology entails important methodological hints for understanding technoscientific artefacts against the backdrop of technoscience as a mobilising force and as a global enterprise. And finally, we outlined how Teilhard's views on the genesis of consciousness, self-consciousness and hyperconsciousness retrieve the historical (dialectical) dimension of phenomenology, thus allowing us to assess the present as a global unfolding of the noosphere.

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Due to the revolutionary achievements of technoscience, philosophy initially seemed to become marginalised, resulting in "object loss", unworldliness and scholarly melancholia. In response to this, continental philosophy retreated into author studies (the library as a nostalgic shrine where the remnants of great thinking are preserved, interpreted and admired). At the other end of the spectrum, since the 1970s, applied philosophy and bioethics entered the scene, so that philosophy became split into two stratums, authors studies and bioethical applications, while the gap between the two seemed increasingly insurmountable. To live up to its pressing vocation of addressing the philosophical dimensions of challenging technoscientific developments and their societal impact, reflection became drawn into research genres such as bioethics and ELSA research (i.e. research into the "ethical, legal and social aspects" genomics, synthetic biology, nanoscience and similar fields), while many continental philosophers persisted in devoting themselves to author studies as an *Ersatzbefriedigung*. As Hegel already argued (1818/1986), however, the vocation of philosophy does not become irrelevant in the era of laboratory science. Quite the contrary: by taking up the unfolding challenge, a new dawn ("*Morgenröte*") seems imminent for a field that had been pushed beneath the bar as it were. An oblique philosophical perspective is as indispensable as ever, although in the current era a comprehensive assessment of the global "spirit" of technoscience requires distributed reflection, involving multiple voices and perspectives, rather than solitary Master thinkers, and resulting in a web-like, global, encyclopaedic process: the evolving outcome of a broad range of scattered but interacting research initiatives. Hegel himself already envisioned his encyclopaedia as a web-like structure (a diamond net of concepts), and Master-authorship has given way to scholarly networks of distributed scholarship, active around the globe.

Mid-way between Hegel and the present, the year 1900 looms up as an important axis point, when Gregor Mendel's work was rediscovered, the quantum concept was introduced by Max Planck, and Marie Curie Skłodowska demonstrated how radium spontaneously emitted light (at the first international physics conference in Paris), demonstrating the interwoveness of energy and matter. These events exemplified the dawning of a new scientific "spirit", as Bachelard phrased it, resulting in a new wave of technoscientific symbolisms, from Mendel's alphabet of dominant and recessive factors (Aa, Bb, Cc, etc.) up to the alphabet of elementary particle physics (e^-, P^+, H^+, H^o, μ, etc.). Not coincidentally, 1900 was also the year in which Freud inaugurated psychoanalysis (by publishing *The Interpretation of Dreams*) and Husserl initiated phenomenology (by publishing his *Logical Investigations*).

What exactly happened in technoscience, and in the world at large, in the *annus mirabilis* 1900? Philosophically speaking, the basic discovery of this scientific revolution, conveyed by core concepts such as "genetic mutations" and "quantum jumps", was the pivotal insight that nature *does* make leaps. While Charles Darwin, for instance, was still immersed in the logic of slow, continuous change (repeatedly quoting the adage *Natura non facit saltus* in *The Origin of Species*), the cesura marked by the year 1900 first of all concerned the sudden eruption of discontinuity thinking. Mutation is the biological equivalent of the quantum leap concept of quantum physics, as Schrödinger (1944/1967) convincingly argued. Thus, the year 1900 signifies the emergence of a metaphysical insight: of discontinuity as a philosopheme, unleashing a “metaphysical mutation”, as Michel Houellebecq, (1998) phrased it, in his novel *Elementary Particles*. Moreover, discontinuity (leap-like change) results from the presence or absence of elementary components: from subatomic particles such as electrons (discovered in 1897) up to genes and nucleotides. Therefore, the miracle year 1900 boosted the symbolisation of life and nature, resulting in myriads of alphabets (e^-, P^+, H^+, H^o, μ, etc.; Ala, Arg, Asn, Asp, etc.; A, B, AB and O, etc.). In life sciences research, for instance, A, C, G and T exemplify the script (λόγος), the letters (στοιχεῖα) of life. Technoscience entails a convergence of physiology and linguistics, transcending the science – humanities divide.

Thus, a core attribute of the new spirit of technoscience was that it entailed a symbolisation or even obliteration of life and matter. In addition, the 1900 turn gave rise to the emergence of new technologies, from X-ray photography up to X-ray crystallography and particle accelerators. Last but not least, while during the 1920s the quantum concept gave rise to quantum physics and the rediscovery of Mendel to genetics (e.g. drosophila research), in philosophy we notice the advent of a continental philosophy of technoscience, represented by Gaston Bachelard (building on Freud and Husserl), but also by like-minded contemporaries such as Alexandre Koyré, Jean Cavaillès and Georges Canguilhem. In the 1920s, these authors (contemporaries of pioneer quantum physicists and geneticists) reinterpreted the history of science as a history of discontinuity, i.e. of ruptures, breaks and revolutions (Simons, 2019).

This spectrum of events allows us to capture the significance of the 1900 transition. As Bachelard phases it, in or around the year 1900, technoscience (techno-phenomenology) became *noumenology*. In other words, technoscience entailed a disclosure and symbolisation of the *noumenal* dimension of the real, revealing that the noumenal real (the “surreal” if you like) is rational (fathomable with the help of technological, symbolic and mathematical procedures). Genes and electrons are not “objects” in the traditional (phenomenal, Kantian) sense of the term. Technoscience revealed the “essence” of things: revealing, for instance, that a virus essentially is a package of genes, i.e. of rapidly replicating molecular informational code. Technoscience signifies how augmented research emancipated from our restricted mental and sensory capacities (so that physics became depth physics, biology depth biology, psychology depth psychology). And the carefully monitored interactions between subjects, instruments and objects (as actants) inside laboratories, is but a small sample of the trillions of interactions and relations, duels and confrontations which entities engage in, in the cosmic drama raging on a cosmic scale (Harman, 2011, p. 63).

Now that technoscience has evolved into molecular biology, X-omics and synthetic biology, and now that Darwinian evolution is rapidly being superseded by the radical technoscientific dexterity which allows humans to consciously modify the molecular programs of life, the impact of this noumenal turn is rapidly evolving before our eyes. The negation or *Entzweiung* that erupted between philosophical reflection and technoscience calls for sublation, for convergence of technoscientific and philosophical expertise. To phrase it in terms of a dialectical syllogism: the first moment entailed traditional research practices which relied on human mental capacities and sense organs and studied phenomena of continuous change (M_1). This was disrupted and negated by the new technoscientific spirit, emerging during the fin-de-siècle era (M_2). The basic philosopheme of continuity thinking ("Natura non facit saltus") was literally negated (by negating/obliterating the "non": "Nature facit saltus"). Discontinuous change was notably real at the noumenal level (e.g. mutations, quantum jumps). At the same time, discontinuity was discovered in the history of science as well (e.g. the micro-history of science, where discontinuous change was now studied from nearby, zooming in on research as a concrete praxis, on the basis of microscopic proximity as it were). The final step is the holistic turn from basic components to complexity, and from micro-reflection towards encyclopaedic aggregation, resulting in the development of a comprehensive, systemic view (M_3), also in philosophy, where microscopic case studies culminate in a diagnostic of the present and a prognostic of the future: a philosophy of the Anthropocene.

Both linguistics and molecular biology study the ways in which combinations of elements convey meaning (information). The overall trend in technoscience, now that life became technologically reproducible, is towards synthesis: a shift in orientation from analysis and "reading" (from genetics up to genomics sequencing) to recombing and "rewriting" (synthetic biology). Evolution no longer requires incomprehensibly vast intervals of time, now that time-lines become compressed, while minimal organisms and other contrivances foster productivity and acceleration in biomolecular research. The global genome and its promises ("promisomics", Chadwick et al., 2013) calls for global reflection (Thacker, 2005) which, besides ethical implications, should also explore metaphysical implications ("depth ethics"), while continental philosophy as a distributed global practice currently evolves from *cis*-continental to *trans*-continental.

Genomics paved the way for redesigning life via CRISPR-Cas9, Multiplex Automated Genome Engineering (MAGE) and similar tools (Doudna & Sternberg, 2017, Church & Regis, 2013). Streamlined versions of microbial genomes and industrial strains of proprietary microbes operate as engines of creation for the assembly-line production of plastic polymers, biofuels, pharmaceuticals, food ingredients, and other neo-products. According to technoscience celebrities such as George Church, anything imaginable can be put together by pre-programmable microbial manufacturing systems. On the global, systemic level, E. coli bacteria may eventually be dispatched to Mars to "terraform" the red planet. And once a sufficient level of aerobic *viriditas* has been achieved, humans may go and live there.[1] Bio-information (barcodes of life) may re-assemble minimal living beings from the chemical mayhem of Martian surroundings (Venter, 2013). Paradoxically perhaps, in an era of global crisis, technoscience is propagating unprecedented confidence in technoscientific prowess, spreading a millenarian credo for a new era (Bensaude-Vincent & Benoit-Browaeys, 2011). Evidently, continental philosophy

[1] Medieval scholar, abbess and composer Hildegard von Bingen (1098–1179) considered *viriditas* ('greenness') as the essence life (Newman, 1998).

should become intensely involved in these debates, guided by a pathos of proximity, a desire to combine critical questioning with pro-activity and relevance. Whereas androcentric biases entailed an exegetic focus on the oeuvres of exceptionally gifted Master-thinkers from the cis-continental past, philosophical reflection today evolves as a deliberative, distributed, embedded and global (trans-continental) activity.

The Technoscientific Revolution and its *Summa*

To capture the present in thoughts means to assess the current technoscientific revolution against the backdrop of previous revolutions. The "first" scientific revolution recorded by philosophical thinking was the dawn of thinking, the axis time (*Achsenzeit*) as Karl Jaspers (1949) phrased it: a global event, represented in the West by the birth of Greek philosophy and Euclidean geometry, culminating in Aristotelean dialectics. Being as such was conceived as a cosmos, in which a perfect geometrical harmony could be discerned: from the concentric heavenly spheres of ancient astronomy down to the elementary platonic solids (elements envisioned as cubes, pyramids, octahedrons, etc.). In ancient Greece, this revolution entailed a syllogistic movement, starting from the *whole* (the cosmos of geometric perfection, M_1), down to exploring the elementary *constituents* (the στοιχεῖα, M_2) of nature, while Plato's theory of the ideal state exemplified the third moment (M_3): a *concrete whole* which was consciously composed in accordance with the logic of Euclidean geometry, – and therefore in accordance with nature (κατά φύσιν). Aristotle's encyclopaedic oeuvre was likewise a concrete universal whole, where all concepts and discoveries (all products of ancient intellectual activities) were systematically processed and comprehensively assembled.

A similar development can be discerned during the medieval era. Now, the Aristotelean encyclopaedia (the ancient *result*) became the starting point (M_1), giving rise to the Islamic Golden Age (from Bagdad to Cordoba), where specific research areas were developed, complementing the Aristotelean corpus, e.g. algebra, astronomy, chemistry and medicine (M_2). This intellectual movement (realising the medieval νοῦς) subsequently spread to occidental regions, where it resulted in scholasticism (the effort to produce a synthesis between Aristotelean thinking and Catholicism, the true religion), but also in logic and experimental thinking (Roger Bacon, Cusanus, etc.), while medieval universities were conceived as strongholds of learning where all branches of research were brought together into a concrete comprehensive universal whole (M_3).

The modern scientific revolution emerged as the antithetic *negation* of Aristotelean thinking. This revolution unfolded during the early modern period and became associated with the discoveries of "scientific heroes" such as Copernicus, Galileo, Boyle, Newton and Lavoisier. Kant's *Critique of Pure Reason* can be considered the proverbial owl of Minerva, taking flight at dusk, providing the epistemological groundwork for this revolution, albeit retroactively as it were. His thinking was analytic rather than synthetic, resulting in a series of dichotomies (pure versus practical thinking, freedom versus determinism, subject versus object, the phenomenal versus the noumenal, etc.). In the context of this "second" revolution recorded by philosophy, we again notice a shift from a basic understanding of the whole – the deterministic universe (M_1) – towards analysing basic constituents, in the context of experimental research, zooming in on specific causal relationships, established with the help of precision instruments (M_2). Scientific experiments are concrete realisations of the logic of causality (e.g. Boyle's experiments concerning the relationship between temperature and pressure of a gas). Yet, as Hegel already argued, in order to understand real nature (e.g. meteorology, the Earth as a system), a holistic turn is required towards a systemic approach (e.g. the Earthly atmosphere as a system of interacting factors: M_3). To achieve this, we must transcend the confines of the laboratory, as an insulated camera obscura, and develop a systemic and encyclopaedic view.

As indicated, the technoscientific revolution commenced around the year 1900 when Mendel was rediscovered, the quantum concept was introduced and Marie Curie demonstrated her radium research. Whereas the early-modern revolution revolved around the experimental method and the principle of causality, the technoscientific revolution gave rise to a new "spirit", as we have seen, superseding the previous scientific revolution by disclosing the noumenal realm of elementary particles of life, energy and matter, and by unleashing research fields such as high energy physics and molecular life sciences, to study nucleotides, amino acids and subatomic particles (from protons and electrons down to the enigmatic Higgs boson) via a combination of advanced experimental technology and advanced mathematics.

This revolution is now culminating into a holistic turn (the third moment). In life sciences research, for instance, the technoscientific revolution can be summarised as a shift from *genes* (e.g. Mendelian genetics, the gene concept, the mutation concept, the emergence of genetics as a field) via genome sequencing and other -omics endeavours towards the synthetic biology of protocells and synthetic cells: as a converging effort, resulting in the synthetic cell as a concrete whole, a convergence of nature and technology, the *concrete universal* of life sciences research. In the synthetic cell as concrete universal, multiple strands of technoscientific research are systematically brought together: the synthetic cell as a technoscientific *Summa*. This dialectical turn towards co-construction and convergence (as the negation of the negation) is symptomatic of the new scientific spirit or zeitgeist, which entails a shift from reductionism towards complexity, so that the behaviour of an entire complex biological system is more important than individual molecular events (Luisi, 2006, xi; Simons 2019, p. 170). By opting for a systemic approach, the focus of inquiry shifts towards *interaction* (between nature and nurture, genome and environment, the technological and the natural, experimentation and computation, basic and applied research, etc.). Thus, the technoscientific revolution realises a shift from elementary particles (quantum physics, genetics, molecular life sciences, etc.) to complexity (understanding the behaviour of complex systems). Whereas technoscience initially focussed on electrons, protons, neutrinos, Higgs bosons, genes, nucleotides and other sur-objects, research is currently zooming out as it were from elementary particles to systems, from the physical laws of gasses to climate research, from sur-objects to mega-objects, or even hyperobjects (Morton, 2013).

At the subject pole of the knowledge production process, we notice a similar dynamic, a shift from differentiation (specialisation into disciplines and sub-disciplines) towards trans-disciplinarity and convergence, and from small-scale research programs to transnational research networks. The holistic turn requires intense collaboration across disciplinary fields. We see this in the development of research *technologies* (e.g. the emergence of "converging" and "enabling" technologies, the emergence of big machines, exemplified by particle colliders, large telescopes, space stations, next generation sequencing facilities, etc.), but also in the *organisation* of research (intense collaboration between research institutes, resulting in the rise of transnational research networks). Convergence of disciplines and institutes is a trans-continental trend, resulting in substantive connections between actors that up till now were operating independently. The restricted consciousness of individuals becomes sublated into a comprehensive noospheric mind or spirit. We may recognise a dialectical syllogism in this development, from small-scale research programs addressing general question via specialisation and differentiation up to convergence (trans-disciplinarity), resulting in the resurge of the idea of an encyclopaedic *Gesamtwissenschaft*, evolving in a distributed manner.

Convergence

In the global research arena, convergence is "in the air". In the U.S., the *National Science Foundation* presented a *Convergence Accelerator* to promote convergence research via "deep" interdisciplinary collaboration and partnerships, not only across disciplines, but also between academic and non-academic stakeholders.[2] NSF defines convergence research as a conjunction of former opposites: use-inspired and application-oriented research now closely *interacts* with basic, discovery-oriented research, while academic research groups team up with societal stakeholders (industry, not-for-profit organisations, government entities, and others), superseding the science-society divide. Convergence requires proactive and intentional management, as well as intensive re-education and mentorship. In March 15, 2019, the NSF Convergence Accelerator was presented via a "Dear Colleague" letter published on the NSF website and addressing the U.S. research community at large.[3] The NSF convergence accelerator focusses on two tracks, namely: "Harnessing the Data Revolution" and "Future of Work at the Human-Technology Frontier". Both themes are self-referential, i.e. directly relevant to technoscience itself, where a big data revolution is surging and research is outsourced to intelligent robotic machines.

[2] https://www.nsf.gov/od/oia/convergence-accelerator/

[3] https://www.nsf.gov/pubs/2019/nsf19050/nsf19050.jsp

Genealogically speaking, the NSF convergence initiative is part of a much longer history, which goes back to the birth of the NSF as such. The creation of NSF as a federal agency was proposed in 1945 by Vannevar Bush, head of the *Office of Scientific Research*, a governmental organisation devoted to managing big science projects, including the Manhattan Project. Vannevar Bush presented his proposal in a report to the U.S. President entitled *Science, The Endless Frontier*, calling for an expansion of government support for post-war scientific research. The report advocated a "big science" approach bent on overcoming the divide between basic and applied research. The Internet (which began as a project named ARPANET, funded by the U.S. military) can be regarded as one of the most notable results of this initiative. The ARPANET was established by the Advanced Research Projects Agency (ARPA) of the United States Department of Defence, and indeed, a substantial number of technoscience activities have been supported by the U.S. military. In the course of modern history, there has been a close alliance between research and the military, also in Europe, and scientific discourse is pervaded with militaristic terms (*strategy*, *mission*, *frontier*, *task force*, *cohorts*, *research intelligence*, *shot-gun approach*, etc.), starting with Plato, who referred to academics as *guardians* – in accordance with Hegel's adage, quoted by Ernst Kapp, that the military belongs to the "intelligence class" (Kapp, 1877/2015, p. 298).

Against this backdrop, the signifier "convergence" conveys a remarkable dialectical reversal. A dramatic dialectical trajectory has unfolded from the initial top-down big science scheme advocated by Vannevar Bush (e.g. the Manhattan project and the "qualified" knowledge it produced) down to current initiatives involving bottom-up stakeholder collaboration, user-oriented research, "bottom-up ethics" (Bard et al., 2018) and Open Science. Big Science projects such as the Manhattan Project entailed an intricate dialectical relationship between S_1 (the U.S. government and its representatives) and S_2 (the brain workers employed at Los Alamos, with Robert Oppenheimer as their chain-smoking research manager, cf. Zwart, 2017). Whereas in the Lysenko case the distance between S_1 and S_2 collapsed, as we have seen, in the NSF Big Science approach the distance was allegedly kept in place to some extent, so that scientists could focus on the technoscientific intricacies of their projects. Still, after the completion of the Manhattan project, politicians and the military *appropriated* the product of the brain-workers' labour (by assuming full control over the atomic bomb, the object *a* of nuclear physics), while Oppenheimer became a target of suspicion and was effectively marginalised (Zwart, 2017). At Princeton, he could retreat into "pure" science again, while from now on "classified" nuclear physics knowledge was considered the property of the state.

For the computer scientists working on ARPANET, this genealogy implied a complicated legacy. The history of the Internet continues to reflect this tension between S_1 (political power, initially represented by the United States Department of Defence) and S_2 (the researchers who wanted to develop a computer network for direct communication and exchange between research teams at universities). Soon, ARPANET escaped from the laboratory, infecting the outside world and evolving into the uncontainable and incontrollable Internet and its multiple bifurcations, the central nervous system of the noosphere.

In current convergence initiatives, we likewise notice a series of dialectical reversals, a dialectical syllogism. In the nineteenth century, research was often conducted by affluent amateurs, whose practices remained close to citizen science (M_1). In the context of technoscience, however, research evolved into a profession, and researchers became specialised brain workers in knowledge factories. This resulted in an epistemic divide between lifeworld experience and laboratory expertise (M_2). Convergence, however, entails the effort to bridge the gap between the two, transforming the lifeworld into a living laboratory (M_3) where myriads of research projects are occurring simultaneously, ranging from big data science (e.g. monitoring click behaviour of consumers) via crowdsourcing down to self-experimentation. Rather than on the expertise of technoscientific experts, the emphasis is now on their knowledge deficits, notably concerning the societal implications of the products of their research (Zwart et al., 2017). Research should become more "inclusive" (Macnaghten et al., 2014; Stilgoe et al., 2013), more sensitive to societal expectations and concerns, by broadening the spectrum of expertise, not only through interdisciplinary collaboration, but also by involving voices, experiences and perspectives from society. Participatory interaction should become an inherent component of research methodologies from the very outset, fostering public engagement and enabling easier access to scientific results (Open Science). In contrast to the deficit model, the focus is on knowledge and experiences available in society and relevant for research. The goal is to further positive societal impact by exploring and co-constructing possible scenarios and to co-create the future.

In the past, technoscientific progress resulted in "epistemicide", *negating* and obliterating practical and indigenous insights and skills ($M_1 \rightarrow M_2$), so that the development of scientific expertise evolved at the expense of other forms of knowledge and even resulted in the active liquidation and elimination of other (rival, traditional or indigenous) knowledge systems (Hall & Tandon, 2017). Now, all citizens are considered experts, to some extent (Collins, 2014). In other words, expertise has become ubiquitous ($M_2 \rightarrow M_3$). We all suffer from multiple knowledge deficits, in the sense that the future is open and indeterminate and it is difficult to predict how technologies will evolve and how the life-world will be affected. To address these deficits, collaboration and convergence (i.e. crowdsourcing distributed intelligence) is paramount. In living labs outside technoscientific laboratories, complex and potentially disruptive innovation processes are evolving, with technologies pervading the life-world, whilst they themselves will be affected by the way they are taken up and put to use. Thus, rather than denying (negating) the expertise of technoscientific experts, this entails epistemic interaction between multiple knowledge forms. Ideally, research is conducted under real-life circumstances. All the world becomes a laboratory, and large numbers of citizens participate in the research, collecting, sharing and questioning data.

Isabelle Stengers likewise argues that the specificity of science should no longer be thematised through hard demarcations between science vs. non-science, science vs. ideology, etc., as exemplified by scientific heroes such as Galileo and more recent versions of "science wars" (Stengers, 1993). Contemporary researchers have different concerns. Research is a creative and vulnerable practice, and scientists are struggling with burn-out, global competition and bureaucracy, e.g. of research funding organisations (Van Tuinen & Bordeleau, 2011). To forego mobilisation by dominant ideologies and power structures, researchers should opt for open science, but also for slow science: slow down! (Stengers, 2013). Science should not race ahead, but acknowledge the importance of interaction with "public intelligence". At the same time, this process calls for new forms of (social scientific) expertise, captured by a plethora of acronyms (STS, ELSI, ELSA, RRI, etc.)

Convergence entails a process of *Entäußerung* (externalisation, Malabou, 1996/2005), as technoscientific expertise opens up to different linguistic spectrums (to other voices). The discourse on "Responsible Research and Innovation" (RRI) explores how inhibitions and resistance among technoscientific experts against societal intrusion can be addressed (Carrier & Gartzlaff, 2020). Convergence is an *idea* which is actively at work, and its logic is becoming pervasive, also in terms of material conditions (infrastructure, training opportunities and funding mechanisms): convergence between Research Performing Organisations (RPOs, e.g. universities), between disciplines (transdisciplinarity), between academia and society (interactive research programs promoted by research funding organisation). The collaboration between academic and industrial actors indicates the extent to which technoscientific research has evolved into a global enterprise, as Heidegger contended.

Interactivity is emerging under various labels: RRI, Open Science, Citizen Science, crowdsourcing and the like. Knowledge deficits can only be addressed through collaboration, not only across disciplines, but also with participants from outside academia (citizen scientists). William Whewell, who invented the word "science", is also credited with coining the term "citizen science" and with organising what is now considered as one of the first paradigmatic citizen science projects, mobilising hundreds of volunteers internationally to study ocean tides. Another field with a long track record of participatory research (citizen science) is meteorology. Gregor Mendel, founding father of genetics, was also a citizen scientist, interested in weather-forecasting as the official weather watcher of Brno, taking meteorological observations daily and sending them to the Vienna Meteorological Institute. Accurate observation and mathematical treatment of data is characteristic of his work in this area as well (Zwart, 2008, p. 203). Meteorology developed vast networks of meteorological stations, so that all the world became a meteorological laboratory. After a period of professionalisation, research is again highly dependent on input from outsiders. Science requires distributed intelligence and participatory methodologies for data collection.

Distributed intelligence culminates in Wikipedia as a citizen science encyclopaedia, involving a global community of volunteers. According to the Wikipedia entry on "Wikipedia", 270.000 active contributors spend millions of hours on maintaining and developing it, and these numbers are continuously (if not exponentially) growing. Journals like *Nature* and *Science* constitute technoscientific encyclopaedias in their own right. Global research produces hypercycles of knowledge production. Etymologically speaking, encyclopaedia (ἐγκύκλιος + παιδείᾱ) can be translated as all-round education, indicating how the idea of a universal mind has now evolved from *homo universalis* into a network concept.

Thus, we move from a traditional encyclopaedia (written by professional experts, M_1) towards a dynamic network concept, where the gap between production and consumption of knowledge gives way to a global community of co-productive consumers (M_2). What is still missing in this massive externalisation, is what Hegel tried to achieve in his enormous project: a *philosophical* encyclopaedia of the arts and sciences, adopting an oblique perspective, a critical sublation of ICT-based discourse (M_3). This would involve a critical and systematic reading and processing of the discourses that are proliferating through technoscientific journals such as *Nature*, *Science*, *Cell*, *PLoS*, etc. In fact, this encyclopaedia is already emerging, albeit not as the work of one (or a limited number of) authors, but as a distributed research program: an emerging, trans-continental philosophical encyclopaedia, to which philosophers from various parts of the globe contribute in an interactive manner (including interminable peer review).

Discourse of Capitalism

We noticed how technoscience is externalising, becoming embedded in global society. This raises the question how technoscientific discourse operates under changing conditions. What kind of discourse is technoscientific discourse under present circumstances, and how does it function in the context of global societal developments? Technoscientific experts are qualified researchers (S_2 in the position of the agent), but they also constitute an authoritative voice (S_1 as powerful Other) whose authority is vehemently questioned by social discontent ($ in the position of the agent). We clearly notice this in the context of the current COVID-19 crisis, for instance. Expert guidance is both called for (as a source of authority, a compass for policy and public behaviour) and vehemently questioned. How to determine the current structure of technoscientific discourse in terms of Lacan's four discourses?

Researchers who analyse the click behaviour of digital consumers with the help of advanced data analysis tools, are still operating within the syllogism of what Lacan referred to as university discourse. The expert (S_2) is the agent, and the clicking fingertip (routinely or hesitantly touching the Enter button) operates as object *a*. In the end, researchers may become frustrated, due to lack of relevance or replicability of the results ($). As indicated in the previous section, however, the knowledge production process is currently drifting towards convergence and externalisation, so that researchers are interpellated by funding agencies and societal stakeholders to legitimise their work in terms of societal impact and boost the societal relevance of their findings. The force field of power and knowledge is shifting. We are not dealing with top-down governmental interventions, as advocated by Vannevar Bush, but with complex interactive processes involving both top-down components (interventions by funding agencies) and bottom-up (upstream) components (public involvement in the knowledge production process, a "democratisation" of knowledge even). What is happening?

One way of looking at it is to argue that technoscience has entered the global *agora:* a global market ambiance where various types of experts offer their views for sale (as in Lucian's play *Philosophers for sale*, but now on a global rather than on a polis scale) and where technoscientific products proliferate. According to Lacan (1972), neoliberalism is the Master's discourse of the present era, placing the market in the position of the governing principle. The Market is no longer a traditional Master interpellating us, however, but a "mutated", protean master (Pauwels, 2019; Olivier, 2009). On the global knowledge market, consumers are relentlessly requesting special products from technoscientific producers. Market mechanisms and digital platforms allegedly bridge the gap between production and consumption, so that consumers (end-users) may continuously interpellate knowledge producers. They may even co-constructively "produce" future products by claiming a say in the production of commodities, and in the knowledge agendas on which these are based. According to Lacan (1972), the neo-liberal market entails a mutation of the Master's discourse in the sense that it *inverses* the relationship between S_1 and $\$$. This results in a "fifth discourse", a "mutant" of the discourse of the Master (Vanheule, 2016):

$\$$	S_2
S_1	a

The consumer (driven by frantic desire, $\$$) now directly confronts the technoscientific expert (S_2). The consumer (or end-user) is relentlessly interpellating established (validated) knowledge. What is the relevance and value of all this knowledge, who will be able to use it and when? Will it put an end to the COVID-19 pandemic, for instance, and the lock-down malaise? Can we speed up vaccine production, the object *a* of epidemiology: the tiny bottle of fluid, to be injected (through a mildly painful needle) into our bodies, so as to flatten the otherwise exponential pandemic curve? While technoscientific experts are monitoring disruptive global processes from behind their screens, and while pharmaceutical companies are producing their precious commodities on a massive scale, citizens and non-governmental organisations (NGOs) call for pro-active interventions. The $\$$ position (upper-left, acting as agent) may be taken by critical societal actors, including NGOs, but may also be adopted by researchers who are questioning the knowledge producing system themselves: experts who acknowledge their knowledge deficits and who become acutely aware of their shortcomings, plagued by self-doubt, questioning the validity of established knowledge, so that technoscience is becoming structurally pervaded with uncertainty. Yet, although the interpellation and questioning may seem authentic and critical, it may at the same time be instigated by the dominant ideology of neoliberalism (S_1) steering us "from below" as it were, pervading the scene. This may help to explain why questions and criticism arising in global societal debate are consistently articulated in terms of the dominant ideology: in neoliberal terms (e.g.

risks, consumer choice, product information, labelling, privacy, consent, intellectual property rights, benefit sharing, etc.).

Last but not least, if individuals become citizens scientists, if publics become actively involved in processes of knowledge production, who may appropriate the surplus value (*a*), the key products of all these efforts in the end? The Corona crisis may again serve as an example here. The initial object *a* is the vaccine, as we have seen, but gradually, displacement may occur, and the focus of attention may shift to something more symbolic, e.g. production numbers or stock exchange quotations of AstraZeneca and other pharma companies. COVID-19 triggers an avalanche of research activities around the globe, mobilising both experts (brain workers) and citizens. The latter are called upon to provide bodily samples in the context of COVID testing, for instance. In the end, however, the key *product* (i.e. the lower-right position in the scheme) is not knowledge as such. Rather, the intentionality of the research community (both academic and industrial) will increasingly focus on developing a commodity, so that the vaccine exemplifies the commodification of technoscience par excellence, representing that which is currently lacking – the object of desire, the immunising, life-saving fluid, which will allow us to overcome the current situation of hibernation and stagnation, and speed up again (the object *a*). The decisive question will be: who will own the property rights of this vaccine? Who can claim ownership rights? This is reflected in the current collision between AstraZeneca and the EU. While the latter provided 2 billion Euros of funding, AstraZeneca allegedly sold its precious commodity elsewhere. While countless researchers, citizens and patients will have contributed to its development, the surplus value (*a*) will be appropriated by the mega-players on the market. While knowledge may eventually serve the benefits of the public by producing special products (i.e. the user value of knowledge), the question remains who will receive the surplus value, who will own the intellectual property rights, the patents, who will receive future funding, acknowledgement and other forms of reward? If the position of $ is actually taken by researchers, they may request revisions of the reward system for technoscientific research. Whereas traditional performance indicators serve as "perverse incentives" (*h*-score or stock exchange quotations as object *a*), critical voices may demand that we should rather go for real impact, relevance and solidarity.

$ (consumers desiring and demanding a vaccine)	S_2 (experts stressing the importance of safety and formal approval procedures)
S_1 (the adage that we are entitled to enjoy life to the full)	*a* (the vaccine: precious, questionable and controversial)

Lacan's intervention, the impromptu introduction of a fifth discourse, indicates that Lacanian psychoanalysis was (and should be) an evolving program, responsive to emerging developments, such as the eruption of the COVID-19 pandemic against the backdrop of neoliberal ideological dominance. The question is, how to master the logic that is actually at work here. Rather than from the "end-users" of technoscientific knowledge products, the interpellation may come from the pervasive logic of the market (from beneath the bar), so that the global market is the real Master

(M_1) who, also in this mutated discourse, continues to speak (via consumers) from underneath the scene.

Neo-Liberalism and Post-Truth

A final symptom of the discourse of capitalism concerns the vicissitudes of truth (the primal signifier of Western thinking) in the post-truth era. Public discourse (above the bar) entails an on-going confrontation between public discontent ($) and technoscientific expertise (S_2) as we have seen, where the latter is represented by researchers, policy makers, managers of big data enterprises etc. The syllogism which aims to move smoothly from agents (vocal consumers) who address their demands to experts (as others), resulting in valuable products (*a*) is disrupted, resulting in symptomatic unintended by-products, revealing a disavowed truth speaking from beneath the bar. In the mutant discourse of neo-liberalism, there is still a truth speaking from beneath (S_1), but it is a kenotic truth, bereft of content: a "Master without qualities", representing the dictates of the calculative logic of the market.

This explains the current crisis afflicting the core signifier of Western thinking (ἀλήθεια), philosophy's primal word as it were: the crisis of truth. The fact that the *Oxford Dictionary* elected "post-truth" as "word of the year for 2016" is symptomatic of this predicament. A chronic disparity, rather than correspondence, has once again arisen between what we claim to know (knowledge) and what is happening out there (reality). The tension as such has always been there of course, as a stimulus for reflection and research. Plato already distinguished ἐπιστήμη (genuine knowledge) from δόξα (opinion). And when Jesus claimed that He had come into this world to testify the truth (John 18:37), Pilate (a scholar, well-versed in philosophy) famously retorted "What is truth?" (Τί ἐστιν ἀλήθεια; John 18:38), thereby entering into a dialogue which pointed to a disparity between the truth of this world and the truth of faith, – a disparity which medieval scholasticism aspired to supersede. More recently, as discussed in Chap. 4, Bachelard distinguished technoscientific validity (*fabricated*, literally, in laboratories) from preconceptions circulating in the lifeworld, from *cis*-truth as it were, at *this* side of the epistemic divide, not yet affected by the cathartic and kenotic operations of technoscience.

According to Heidegger, writing in the 1930s, however, this disparity has now radically aggravated, giving rise to what he referred to as a "collapse" of truth ("Einsturz der ἀλήθεια", 2014, p. 224). For Heidegger, this event was closely related to the radical instrumentalization and mobilisation of knowledge by what he referred to as meta-politics (Nazism, Americanism, Communism): the mobilisation of brain power by state power (as advocated by Vannevar Bush, for instance, in *Science: the Endless Frontier*, discussed above). In the context of global neo-liberalism (as a contemporary version of meta-politics) the political constellation has radically changed, but the crisis or collapse of truth has clearly manifested itself.

The post-truth era is characterised by a pandemic of disregard for truth. The global public environment has become a data-sphere, where terabytes of data are relentlessly circulating. The data deluge threatens to make the concept of scientific truth obsolete, to the extent that anything can be verified by adapting algorithms to desired outcomes. This results in an erosion of the credibility of technoscientific expertise (S_2), relentlessly interpellated by public discontent ($). Although many academics currently deplore this disregard for truth in the post-truth era, up to the point of launching marches for science (marches on behalf of scientific truth), they must be aware of their own involvement, to prevent becoming entrapped in the position of the Beautiful Soul (bemoaning the current crisis while overlooking how they themselves are deeply *involved* in what they deplore). For the erosion of truth has been actively promoted by academic scholars themselves. Researchers in the field of Science and Technology Studies (STS) should be mentioned here, for instance, intent on exposing how scientific facts are socially constructed. According to hard-core STS, scientific truth is determined by experts in the context of power games. Truth is the outcome of social processes and political negotiations, it is what certain self-serving coalitions of experts temporarily present as truth. For STS, the adoption of post-truth politics by politicians like Donald Trump evidently became a source of embarrassment, of trauma even. In 2004, Bruno Latour (one of the founding-fathers of STS) already criticised his own field for spreading the message that scientific facts are to be distrusted and that there is no such thing as truth. In retrospect, Latour deplored how right-wing "extremists", by questioning expert views concerning climate change for instance, appropriated STS strategies, so that their conspiracy theories seemed uncannily similar (in terms of argumentative structure) to former STS ideas. Latour now considered it a mistake that he had moved *away* from "matters of fact" (p. 231) and that he had contributed to "debunking science" (p. 232). According to Latour, post-truth politics is like critical radicalism gone mad, as if the STS virus of critique had escape from the scholarly laboratory, so that its deleterious effects could no longer be contained; as if the virus of criticism had mutated into a right-wing mutant and is now gnawing everything up (p. 231). Similar retractions were published by Sheila Jasanoff,[4] Sergio Sismondo (2017) and other TS protagonists.

How to respond to this situation from a continental philosophical perspective? Dialectically speaking, the response to this *negation* or even elimination of truth cannot be a relapse into a Master's discourse. Although a "return to" the oeuvres of previous thinkers (as a source of inspiration) is a crucial and recurring moment within a more comprehensive methodology, the ultimate objective is not restauration (the re-instalment of S_1 in the upper-left position, with experts functioning merely as oeuvre stewards). Rather we should aim for a *negation of the negation*, actively addressing the challenges emerging under current circumstances, thereby raising philosophy to its current task. The data deluge calls for an Encyclopaedia of the Philosophical Sciences 2.0. as a collective endeavour, articulating and

[4] http://first100days.stsprogram.org/2017/03/28/what-should-democracies-know/

questioning the basic philosophemes at work in current data flows, revealing how discourse under neo-liberal circumstances is driven by desire.

Under the sway of neo-liberalism, the focus of the knowledge production process is no longer on knowledge as such (S_2) but on the surplus value generated by the process (e.g. commodities enhancing enjoyment, *h*-scores, university rankings, Intellectual Property Rights, and other perverse incentives). Therefore, the discourse of the analyst focuses on the role of *a* as agent or actant. Performance indicators evolve into perverse incentives, frantically pursued by research communities under pressure who are drawn into action by these scores, sometimes even reverting to manipulation ($), for instance via data manipulation, author inflation, paper recycling, etc. Against this backdrop, continental (transcontinental) philosophical reflection aspires a critical reconsideration of the basic philosophemes at work in thus process (S_1). Besides "nature", "technoscience", "democracy", etc., this also involves a reconsideration and rehabilitation of the concept of truth. Like the question "What is nature?" discussed earlier, the question "What is truth?" may seem an impossible question, but it is also a question which has become impossible not to ask.

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